Food and Ectoparasites of the Southern Short-tailed Shrew, *Blarina carolinensis* (Mammalia: Soricidae), from South Carolina

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ABSTRACT—Food habitats and ectoparasites were examined in a sample of 50 individuals of *Blarina carolinensis* collected in a hardwood forest on the Coastal Plain of western South Carolina. Both in terms of volume and frequency of occurrence, predominant foods were slugs and snails (Mollusca), the hypogeous fungus *Endogone*, earthworms (Annelida), and beetle (Coleoptera) adults and larvae. Ectoparasites observed on *B. carolinensis* included one species of flea (*Doratopsylla blarina*), one species of beetle (*Leptinus americanus*), and 25 species of mites, the most frequent being *Orycteroxenus soricis*, *Asiochirus blarina*, *Echinonyssus blarinae*, *Haemogamasus liponyssoides*, and several species of *Pygmephorus*.

A good deal of information exists on the foods and ectoparasites of the northern short-tailed shrew, *Blarina brevicauda* (Say 1823); however, this is not the case for the southern short-tailed shrew, *B. carolinensis* (Bachman 1837). We are not aware of any detailed information on the foods eaten by *B. carolinensis*, and know of only five species of ectoparasites that have been reported: the laelapids *Androlaelaps fahrenholzi* and *Haemogamasus harperi* by Hayes and Guyton (1958), *Eulaelaps stabularis* by Hayes and Guyton (1958) and Jameson (1947), and *Myonyssus jamesoni* by Ewing and Baker (1947),

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and the myobiid *Blarinobia simplex* by Ewing (1938). The purpose of this paper is to present data on the food habits and ectoparasites of *B. carolinensis* from South Carolina, and to compare these with data that have been reported for *B. brevicauda*.

MATERIALS AND METHODS

Shrews were collected over a 21-day period in May 1986 from the Savannah River Ecology Laboratory's Mill Creek small mammal trapping grid. The Mill Creek grid is located in a mixed hardwood cove forest located on the United States Department of Energy's Savannah River Site, near Aiken, South Carolina, and is on the western-most Coastal Plain of the State; specifics of grid dimensions and habitat structure have been described elsewhere (Gentry et al. 1968, 1971). One Museum Special and one Victor mouse trap were set at each station of the grid; traps were baited with peanut butter and checked daily. Captured shrews were placed in individual plastic bags and frozen for later examination.

Stomach contents of each animal were removed and then identified under a dissecting microscope. The volume of each item in each stomach was estimated visually. Data were compiled as percent frequencies (percentage of shrews with each item) and percent volumes (average percentage of each food) of each item observed in the entire sample.

We collected ectoparasites by examining the fur with a dissecting microscope. When ectoparasites were observed to occur in relatively small numbers, all individuals were collected; when the numbers of ectoparasites were large, the numbers individuals of each species were estimated, and samples were taken of each. Data on food habits and ectoparasites were compared to similar data for *B. brevicauda* from Indiana (Mumford and Whitaker 1982). Shrews from Indiana were collected from a variety of habitats.

RESULTS

Foods

Forty-five of the 50 individuals of *B. carolinensis* examined contained food, totaling 23 items (Table 1). The five dominant foods were slugs and snails (18.5% of total volume), the hypogenous fungus *Endogone* and related genera (16.3%), earthworms (14.8%), unidentified adult beetles (9.6%), and unidentified beetle larvae (5.8%). Total volumes of Coleoptera, Lepidoptera, and Diptera were 17.8, 6.0, and 6.7%, respectively. No single food item clearly was dominant in the sample of *B. carolinensis*; slugs and snails, *Endogone*, and earthworms were

Table 1. Food items observed in the stomachs of 45 short-tailed shrews (*Blarina carolinensis*) from South Carolina and 125 *B. brevicauda* from Indiana (Mumford and Whitaker 1982).

	B. carolinensis		*B. brevicauda*	
	Volume	Frequency	Volume	Frequency
Slugs and snails	18.0	26.8	8.5	14.4
Endogone (and related genera)	16.3	29.3	3.6	11.2
Earthworms	14.8	22.0	37.5	48.1
Coleoptera adults	9.6	19.5	4.2	7.2
Coleoptera larvae	5.8	24.4	4.0	7.2
Spider	4.6	9.8	0.5	2.4
Lepidoptera larvae	3.7	7.3	8.2	16.8
Unidentified larvae	3.6	4.9	0.3	1.6
Diptera adults	3.0	4.9	0.3	1.6
Phalangida	2.4	2.4		
Scarabaeidae larvae	2.4	2.4	0.8	0.8
Lepidoptera adult	2.3	2.4	0.1	0.8
Cricket	2.1	4.9	6.2	8.8
Tipulidae	2.1	2.4		
Unidentified	1.8	9.8		
Muscoid Diptera	1.6	2.4	0.8	0.8
Hemiptera	1.3	4.9	1.0	2.4
Vegetation	1.2	2.4	2.2	11.2
Insect	1.1	2.4	3.8	14.4
Vertebrate	1.0	2.4	0.3	0.8
Formicidae	0.6	4.9	0.5	4.5
Chilopoda	0.5	2.4	4.5	8.0
Hemerobiidae	0.1	2.4		
Carabidae			2.7	4.0
Dipterous larvae			1.8	5.6
Isopoda (sowbugs)			1.6	1.6
Pentatomidae			1.4	3.2
Scarabaeidae			1.1	3.2
Elymus seeds			0.8	0.8
Coleoptera: pupae			0.8	0.8
Acrididae			0.8	0.8
Orthoptera: internal organs			0.7	0.8
Plecoptera			0.6	0.8
Curculionidae			0.6	1.6
Mast			0.6	1.6
Gryllacrididae			0.4	0.8
Enchytraeidae			0.2	0.8
Syrphidae			0.2	0.8
Cicadellidae			0.1	0.8
Staphylinidae			0.1	0.8

represented about equally and collectively comprised about half of the food in the sample. Whereas no food item was dominant in the sample of *B. carolinensis*, earthworms clearly were dominant (37.5% volume) in *B. brevicauda*, followed by slugs and snails (8.5%), lepidopterous larvae (8.2%), Gryllidae (6.2%), and Chilopoda (4.5%) (Table 1).

Ectoparasites

Ectoparasites were observed on all *B. carolinensis* examined, and individuals of 27 different species were collected (Table 2): one species of flea (*Doratopsylla blarina*), one species of beetle (*Leptinus americanus*), and 25 species of mites from eight families (Acaridae, Anoetidae, Cyrtolaelapidae, Laelapidae, Listrophoridae, Myobiidae, Pygmephoridae, and Trombiculidae). Both in terms of the percentage of hosts infested and the mean numbers observed per host, the most frequently observed ectoparasites on *B. carolinensis* were *Echinonyssus blarinae*, *Haemogamasus liponyssoides* (Laelapidae), *Asiochirus blarina* (Listrophoridae), *Orycteroxenus soricis* (Acaridae), and *Protomyobia blarinae* (Myobiidae).

Doratopsylla blarina, the only flea observed on *B. carolinensis*, was the second most abundant of the six flea species observed on *B. brevicauda*. The acarid mite *Orycteroxenus soricis* occurred on both species of shrew, but two acarid hypopi, *Xenoryctes latiporus* (only on *B. carolinensis*) and *Dermacarus hypudaei* (only on *B. brevicauda*), also were present. *Asiochirus blarina* was the only listrophorid collected; it occurred on both species of shrew. Five species of laelapid mites were collected from *B. carolinensis*, as compared to eight species on *B. brevicauda*. The laelapid species *Haemogamasus liponyssoides* was one of the two most abundant ectoparasites on both species of shrew. *Echinonyssus blarinae* was more abundant on *B. carolinensis*, whereas *Androlaelaps fahrenholzi* was the most abundant laelapid on *B. brevicauda*. Seven species of *Pygmephorus* were collected from *B. carolinensis*, and 12 species from *B. brevicauda*.

Of the 11 species of pygmephorids observed on *B. carolinensis*, four were in the genus *Bakerdania*, a genus that was not observed on *B. brevicauda*. Three species of *Bakerdania* probably are undescribed. Thirteen species of ectoparasite (1 flea, 1 beetle, 11 mite species) were common to both species of *Blarina*. Fourteen species of ectoparasites were observed only on *B. carolinensis*: these 14 consisted of one laelapid, one acarid, eight species of pygmephorids, two cyrtolaelapids, an anoetid, and a chigger (Trombiculidae). Of the 32 species reported for *B. brevicauda*, 19 were found only on that host. The 19 consisted

on five species of fleas, four species of laelapid mites, one species of acarid mite, and a species of *Pygmephorus*.

DISCUSSION

Both *B. carolinensis* and *B. brevicauda* eat a wide variety of foods: 23 categories of food items in the South Carolina material (n = 45), compared with 36 categories in the much larger sample of *B. brevicauda* (n = 125) from Indiana. The lower percent volume of earthworms observed for *B. carolinensis* likely represents the low numbers of earthworms that are supported by the sandy soils of the Savannah River Site, rather than a difference in dietary preference between *B. carolinensis* and *B. brevicauda*.

The hypogeous mycorrhizal fungus *Endogone* was one of the more heavily eaten foods in the shrews from South Carolina at 16.3% of the volume, but formed only 3.6% of the total volume in the foods of Indiana shrews. *Endogone* (including related genera, see Castellano et al. 1989) often is important as a food of small mammals (Whitaker 1962, Williams and Finney 1964). The small mammal–fungal relationship is an important component of many communities because small mammals act as dispersal agents for mycorrhizal fungi (Maser et al. 1978).

Of the five ectoparasitic species that previously had been reported from *B. carolinensis*, all were found during our study (marked with asterisks, Table 2) except for *Haemogamasus harperi*. The flea most frequently observed on *B. brevicauda*, *Ctenopthalmus pseudagyrtes*, was not collected from *B. carolinensis*; however, *C. pseudagyrtes* does occur on the Savannah River Site, and has been observed on eastern moles, *Scalopus aquaticus* (G. D. Hartman, unpublished data). The most abundant mites on *Blarina* tend to be the tiny *Asiochirus blarina* (Listrophoridae) and hypopi of *Orycteroxenus soricis* (Acaridae); both of these ectroparasites likely were more abundant than the data indicate.

The number of ectoparasite species observed on *B. carolinensis* was less than for *B. brevicauda*, in part because of the smaller number of *B. carolinensis* examined. However, in spite of the different sample sizes, there were notable differences between the ectoparasite assemblages. Of 27 species observed on *B. carolinensis*, 14 were found only on this host, and of the 32 species reported for *B. brevicauda*, 19 were found only on that host. Anoetids, cyrtolaelapids, trombiculids, and the genus *Bakerdania* (Pygmephoridae) were observed only on *B. carolinensis*. Although the species of *Pgymephorus* found on the two host species were not similar, this is not too surprising because pygmephorid mites that occur on mammals are not host specific.

Table 2. Ectoparasites from 50 individuals of *Blarina carolinensis* from South Carolina compared with those from 92 of *B. brevicauda* from Indiana (Mumford and Whitaker 1982).

	B. carolinensis				*B. brevicauda*	
Ectoparasite Taxon	Number	Percent[1]	Number	$\bar{x}$[2]	Percent	$\bar{x}$
SIPHONAPTERA (fleas)						
Ctenopthalmus pseudagyrtes Baker					15.2	0.32
Doratopsylla blarinae Fox	9	18.0	12	0.20	7.6	0.18
Epitedia wenmanni (Rothschild)					3.3	0.04
Stenoponia americana (Baker)					1.1	0.02
Corrodopsylla hamiltoni (Traub)					1.1	0.01
Orchopeas howardii (Baker)					1.1	0.01
COLEOPTERA (beetles)						
Leptinus americanus LeCont	1	2.0	1	0.02	4.3	0.05
ACARINA (mites and ticks)						
LAELAPIDAE						
Echinonyssus blarinae (Herrin)	32	64.0	218	4.40	1.1	0.01
Haemogamasus liponyssoides Ewing	26	52.0	65	1.30	10.9	0.30
**Androlaelaps fahrenholzi* (Berlese)[3]	13	26.0	20	0.40	23.9	0.70
**Eulaelaps stabularis* (Koch)	7	14.0	9	0.20	7.6	0.08
**Myonyssus jamesoni* Ewing and Baker					2.2	0.30
Haemogamasus longitarsus (Banks)					1.1	0.05
Laelaps kochi Oudemans					1.1	0.01
Androlaelaps casalis (Berlese)	1	2.0	1	0.02		
Haemogamasus ambulans (Thorell)					1.1	0.01
Orycteroxenus soricis (Oudemans)	24	48.0	102	2.40	15.2	13.50
Xenoryctes latiporus Fain and Whitaker	11	22.0	25	0.50		
Dermacarus hypudaei (Koch)					1.1	0.01
LISTROPHORIDAE						
Asiochirus blarina Fain and Hyland	26	52.0	127	2.50	15.2	28.40

MYOBIIDAE						
Protomyobia blarinae Lukoschus et al.	19	38.0	141	2.80	3.3	0.14
**Blarinobia simplex* (Ewing)	5	10.0	8	0.20	3.3	0.03
PYGMEPHORIDAE						
Pygmephorus johnstoni Smiley and Whitaker	4	8.0	6	1.10	(3)[4]	
P. horridus Mahunka	13	26.0	25	0.50	(6)	
P. tamiasi Mahunka	10	20.0		0.40		
P. whartoni Smiley and Whitaker	18	36.0		0.50		
P. whitakeri Mahunka	1	2.0	1	0.02	(4)	
P. hamiltoni (near) Smiley and Whitaker	15	30.0	34	0.70	(27)	
P. rackae Smiley and Whitaker					(16)	
P. scalopi Mahunka					(5)	
P. designatus Mahunka					(3)	
P. equitrichosus Mahunka					(2)	
P. moreohorridus Mahunka	2	4.0	2	0.04		
P. faini Smiley and Whitaker					(2)	
P. spinosus Kramer					(1)	
P. brevicauda Smiley and Whitaker					(1)	
P. hastatus Mahunka					(1)	
Bakerdania plurisetosa Mahunka	5	10.0	6	0.10		
Bakerdania sp. (3 species, probably all new)	4	8.0	6	0.10		
CYRTOLAELAPIDAE						
Cyrtolaelaps sp.	16	32.0	28	0.60		
Euryparasitus sp.	1	2.0	1	0.02		
ANOETIDAE						
Prowichmannia spinifera (Michael)	11	22.0	15	0.30		
TROMBICULIDAE (chiggers)						
Comatacarus americanus Ewing	14	12.0	6	0.30		

[1]Percentage of hosts infested. [2]Mean number per host (not per infested host). [3]Ectoparasitic species previously reported from *B. carolinensis* are marked with an asterisk. [4]Values for the numbers of individuals of *Pygmephorus* from Indiana (in parentheses) are numbers actually identified from that host, not the number estimated or counted; the numbers taken were much larger.

CONCLUSION

We report the first study of the food habits of *B. carolinensis*, and we increased, by more than five-fold, the number of species of ectoparasites known to occur on this shrew. However, the specimens of *B. carolinensis* that we examined were collected from a single locality in less than one month. Further studies on *B. carolinensis* from different localities, habitats, and times of the year are needed to account for any temporal or spatial variation in food habits and the occurrence of ectoparasitic species, and to further elucidate the differences or similarities between *B. carolinensis* and *B. brevicauda* in their food habits and ectoparasite assemblages.

ACKNOWLEDGMENTS—We wish to thank T. M. Padgett and an anonymous reviewer for comments and suggestions that improved the manuscript. Financial support for portions of this research were provided by contract DE-AC09-76SROO-819 between the United States Department of Energy and the University of Georgia.

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Received 8 March 1994
Accepted 16 September 1994